Annex F: Space

General

To support the ongoing Transformation process, the Army has revised its overall modernization strategy into a focused effort devoted to achieving essential capabilities for the future while, at the same time, providing the greatest capability possible for the current force. Modernization of space is required to meet the needs of both current and future forces.

Achieving the information superiority underpinning of ***Joint Vision 2020*** (*JV 2020*) and the lighter, faster, more lethal force of the Objective Force era will depend, to an even larger extent, upon the modernization of space-based capabilities. Today, space capabilities make unique and essential contributions to land force command and control, communications, intelligence, surveillance, reconnaissance, missile warning, weather, terrain and environmental monitoring, and navigational and timing support. Unfortunately, as these enhanced capabilities are achieved, our vulnerability is also increased. To ensure access to space and space capabilities, space control is taking on increased significance for land forces, driven in part by the rapid growth in commercial and international space capabilities. In the far-term, these concerns may expand to include modernization related to force application from space.

Because space capabilities are inherently joint and are spread over several Army battlefield operating systems, space capabilities support all the enhanced operational concepts of *JV 2020*. As a result, the overall, synergistic benefit of space capabilities is not always readily apparent. This diversity also means that modernization of space programs is a challenge to coordinate. To assist in this process, the Army has designated Army Space and Missile Defense Command (SMDC) as the specified proponent for space and the integrator of space activities for the Army. Full integration of space capabilities in land force operations is essential to achieving the Army's Transformation objective. To this end, the Army has embedded a Space Operations Cell (SOC) into the Interim Division design, and SMDC will advocate its inclusion in the Corps redesign. Consisting of Functional Area (FA 40) Space Operations Officers and enlisted support personnel, the SOC will enable ground component commanders to fully exploit space system capabilities by bringing the specialized space operational expertise to bear in the planning and execution of land operations.

The systems that provide space capabilities to the warfighter have modernization programs to ensure the readiness of the Legacy and Interim Forces and to ensure meeting the demands of the Objective Force. Army operational capabilities are often assessed along functional or battlefield operating system lines. Not a traditional operating system in it's own right, space significantly enables

many traditional military functions. Without going into system details, this annex touches on a variety of space-related systems to give readers a broad view of how Army space modernization contributes to the future success of land component forces. Three perspectives are given—first through the lens of the five *JV 2020* operational concepts, then from a functional area perspective, and finally through the space modernization programs themselves. The annex concludes with an assessment of the overall status of space modernization in the Army.

Army Space Overview

Through robust beyond line-of-sight (BLOS) connectivity and its ultimate high-ground perspective, space systems provide warfighters near- and real-time situational awareness of force composition and disposition, detailed knowledge of battlespace and associated environment, the status of support and sustainment efforts, and the linkages military leaders require to plan and execute dynamic military operations.

Space capabilities cannot be viewed as “nice to have.” From an Army warfighter perspective, space came into it’s “tactical own” during Desert Shield/Desert Storm and remains a key enabler for warfighters today. Space capabilities will steadily become even more mission-critical as the Interim Force takes shape and the Army begins to transform ultimately into the Objective Force. Space provides, and will continue to provide, perhaps the Army’s most important combat multiplier. Space systems, including their ground segments, enhance Army capabilities in Command, Control and BLOS communications; Intelligence, Surveillance, and Reconnaissance (ISR); Position, Navigation, and Timing (PNT); Weather, Terrain, and Environmental Monitoring (WTEM); and Missile Warning (MW). Because these functional capabilities are so critical to the warfighter, we must also expand and enhance space control capabilities that will assure our access to space and deny that access to our adversaries. Collectively, these space capabilities are a key enabler for achieving the Objective Force characteristics articulated in the Army Vision. Space capabilities are essential for accomplishment of the Transformation objective.

The Army’s evolving space operations Warfighting Concept recognizes the importance of space capabilities to land force operations. It describes the future battlespace as a “seamless, vertical continuum" and recognizes that the land force commander must have direct access to space capabilities and control over the effects of space-based platforms. The concept also recognizes the interdependence of space systems and land force operations by articulating the requirement for mutual support. The Army's approach to this goal is through the full and seamless integration of space and land force operations. Modernization of space systems that provide enhanced

operational capabilities must be synchronized with modernization of other Army systems and forces and with joint space capabilities.

Space Modernization in Support of *JV 2020*

Planning

The traditional emphasis for Army space capabilities has been on ground terminal development. There will be a continuing effort to field enhanced ground-based terminals and receivers, and to ensure they are upgraded to keep pace with improvements to space-based sensors and communications systems. However, Army space modernization interests also include other segments of space architectures and systems. There are increasing Army efforts to identify and leverage joint, commercial, civil, and allied space opportunities with operational and tactical warfighting potential. The Army has also increased participation in the design of joint and national space systems and architectures. The emphasis here is on developing and integrating Army requirements to ensure that joint and national systems support the mission needs of land forces.

Army space modernization planning is also consistent with the overall Army modernization strategy. The Army's concept and technology development efforts for space are directed at ensuring the necessary full spectrum capabilities will be available for the Objective Force to achieve the characteristics described in the Army Vision and to execute the enhanced operational concepts of *Joint Vision 2020*. In the near-term, Army space systems are being upgraded to keep pace with user demands for accurate, secure, and timely information for the Legacy and Interim Forces. Preplanned Product Improvements (PPI) to Army legacy systems take advantage of future architectures and spacecraft advances.

Army space modernization efforts to enhance warfighter support from space focus on establishing Information Superiority and enabling the enhanced operational concepts of *JV 2020*. The priorities are:

- Supporting Satellite Communications (SATCOM) growth and connectivity,
- Resolving Global Positioning System (GPS) vulnerability in the near term,
- Improving ISR timeliness and assured receipt to the warfighter, and
- Developing space control capabilities to assure access to key space capabilities and denying access to our adversaries.

Contributions to the *JV 2020* Enhanced Operational Concepts

Space is well suited to supporting global, force projection operations, as well as in-theater operations in a dynamic, multidimensional battlespace. Space products and services enhance the effectiveness of individual Army systems by providing the advantages of the high ground on a grand scale while being relatively

less vulnerable and politically encumbered than terrestrial or aerial systems. Space is an enabling companion to battlefield digitization, enhancing the overall capability to exploit information, to direct forces, and to mass the effects of the joint force throughout an area of operation. The synergy created by space applies not only to operations during major regional conflicts, but also to full spectrum operations including peacekeeping/enforcement and humanitarian assistance.

Information Superiority

The forward presence and global communications provided by space systems make them essential to gaining information superiority and the conduct of information operations. Space support is especially valuable during rapidly developing force projection operations in immature theaters.

Space systems, integral to information operations, contribute to the collection, processing, dissemination, and use of battlefield data and tactical information. Furthermore, Army space programs and initiatives contribute to situational awareness and understanding of an adversary's information-related capabilities and friendly force capabilities for degrading or denying enemy information. The force enhancement functions of space —WTEM, ISR, MW, and PNT— support situational awareness throughout the multiple dimensions of a battlespace. Through the use of ground segments such as Small Tactical Terminals (STT) and Integrated Meteorological System (IMETS), space systems will provide environmental and terrain conditions in threat-occupied areas where directly observed surface information is unavailable. Land force commanders will have access to several atmospheric and ground parameters, to include soil moisture, which enables trafficability assessments. The Battlefield Ordnance Awareness (BOA) demonstration is researching technologies to provide space-based sensors to detect and characterize ordnance events on the battlefield. The Space-Based Infrared System (SBIRS), designed primarily as a ballistic missile launch detection sensor, will contribute further to situational awareness by detecting and categorizing other infrared-detectable battlespace characterization and technical intelligence events on the battlefield.

As more nations gain access to space capabilities, the need to control space will become a military necessity. There is already wide availability of global, satellite-based communications systems that have military utility, and the availability of high-resolution commercial imaging is a source of great concern. As order-to-delivery times decrease, commercial imaging systems will be capable of providing tactically significant products to potential adversaries. This capability could assist an adversary's implementation of an anti-access strategy and potentially limit U.S. military options. Space control will be an essential element in ensuring theater access, access to space and space capabilities, and land force information superiority. Future Army operations

and equipment will require information operations methods that exploit an adversary's space capabilities and protect friendly forces from space-based observation. These will include capabilities for in-theater space surveillance; protecting vital Command, Control, Communications, and Intelligence Surveillance and Reconnaissance (C3ISR) assets; and deceiving, denying, degrading, disrupting, and/or destroying an adversary's space systems when directed.

Dominant Maneuver

The various Military Satellite Communications (MILSATCOM) programs support communication requirements at all echelons during force projection. Included are secure, reliable, high-capacity (wide bandwidth and multichannel) service and en route mission planning and rehearsal capabilities. Increasingly, commercial space initiatives will also augment military space. Grenadier BRAT (GB), which integrates GPS and communications technology, enables extended range reporting of friendly locations and status. GB also provides a link between digitized and nondigitized forces such as members of a coalition. GPS receivers enable elements to know precisely where they are, even when the surrounding terrain is unfamiliar, uncharted, or featureless. The Tactical Exploitation Station (TES), a Tactical Exploration of National Systems (TENCAP) system, will provide a highly deployable, integrated, scaleable intelligence system specifically designed for split-based operations. Its versions will have robust global and tactical communications connectivity. It will serve as a preprocessor of the All Source Analysis System (ASAS), the Joint Surveillance Target Attack Radar System (JSTARS) Common Ground Station (CGS), and the Digital Topographic Support System (DTSS).

Space products and services enable high-speed, dispersed maneuver and synchronized theater-wide application of firepower and massing of other battlefield effects. The timing required to coordinate decisive operations is enhanced by the precision PNT capabilities afforded by GPS, near-real-time ISR of space-based sensors, and the capability to access high-volume, digitized information in various forms via Military Satellite Communications (MILSATCOM), Global Broadcast Service (GBS) and national intelligence assets.

Precision Engagement

Several space integration initiatives support this enhanced operational concept. Embedded GPS receivers on weapons platforms and guided munitions support extended-range engagements required to shape the battlespace in depth. The situational awareness enabled by Army TENCAP's exploitation of national technical means is a major element in seeing the battlespace early and continuously. The field artillery's Profiler system will benefit from integrated space-based weather data. The Eagle Vision II tactical ground station will provide warfighter access to the growing array of commercial imagery products. An adjunct to the GB system—Army Command and Control Space Enhancement Program

(AC^{2}SEP)—will demonstrate the use of a laser designator in conjunction with the GB terminal for extended-range target designation. Future space sensors will detect ground targets and link with distributed common ground stations, such as TES, providing target information directly to the tactical warfighter. Conceptual analyses are also ongoing for joint space operations that may include Force Application from space in the context of fire support to land forces.

Full Spectrum Protection

JTAGS receives ballistic missile launch data collected by Defense Support Program (DSP) surveillance satellites. JTAGS enables early warning to deployed forces by providing the theater commander an in-theater processing capability that computes the estimated launch point and predicted impact point. This enables implementation of timely passive defense measures, as well as Joint Theater Missile Defense (JTMD) attack operations that may include Unmanned Aerial Vehicles (UAV), Special Operations Forces, Apache helicopters, and Army Tactical Missile Systems. Expanded battlespace and efficient fire distribution for Patriot and other active defense systems are also supported by JTAGS. In the mid-term, the SBIRS surveillance satellites will increase the accuracy and timeliness of launch point estimation and impact point prediction data provided by the improved JTAGS, the Multi-Mission Mobile Processor (M3P). Transmitting theater missile launch warning to handheld pagers has the potential to provide additional minutes of warning time to soldiers in the impact area. Warfighter I, an Air Force-led experiment, will assess the tactical utility of hyperspectral imagery sensors to detect and characterize environmental threats and manmade threats, such as minefields and obstacles, to land forces.

Focused Logistics

Military SATCOM, augmented by commercial space communications, will enable logistics management by staffs in CONUS or other home bases, providing the capability to exchange and update large databases between split-based elements. Supplies in transit or in-theater can be tracked by satellite-based communications linked to GPS. Such capabilities could reduce the need for large holding yards of equipment and containers. They also make logistics more agile, permitting en route visibility of assets and dynamic transport of supplies into theater. Added benefits will be reductions in the in-theater force and strategic lift requirements as well as reduced vulnerability. GBS will have the potential to support soldier services and will provide a means to maintain current situational awareness on theater-specific information. Such capabilities will be especially valuable during extended deployments involving the full spectrum of military operations from humanitarian assistance through major conflict.

Functional Area Force Enhancements

Satellite Communications (SATCOM)

Army forces are dependent on electronic communications, both line-of-sight (LOS) and beyond-line-of-sight (BLOS), with operational concepts increasingly dependent on assured BLOS communications. The communications architecture, largely space-based, is the “backbone” that enables forces to leverage all other space capabilities. Robust, reliable, space-based communications provide key capabilities to land forces.

To enhance the benefits of space-based communications in the Legacy and Interim Forces, the Army is fielding smaller, more versatile, more mobile, secure, multiband/multipurpose SATCOM terminals. The Legacy and Interim Forces will have improved capability to extend terrestrial networks, achieve BLOS capability, enable reachback, and have a reduced required lift and improved data distribution to meet today's demands for voice, data, and imagery transmissions. MILSTAR satellites and terminals will provide Legacy, Interim, and Objective Forces with protected/anti-jam satellite communications currently not available to our tactical forces at corps level. SATCOM terminals for the Objective Force will focus on increased capacity, global broadcast capabilities for rapid dissemination of information, increased integration, and better mobility.

Position, Navigation, and Timing (PNT)

All-weather, accurate PNT provided by GPS satellites is critical to battlespace awareness, enhanced lethality, and survivability. The user segment consists of receivers that accept the satellite signals and compute position and time for the user–a capability that enhances combat identification and blue force tracking (reducing and preventing fratricide), precision targeting, and synchronization on the battlefield. The GPS User Equipment (UE) family consists of different models meeting needs that range from the foot soldier to high performance weapons platforms.

On-going efforts to embed, integrate, and miniaturize GPS into our equipment and weapons platforms highlight the criticality of this capability across the spectrum of operations and our increasing reliance on GPS satellites. However, the vulnerability of GPS to jamming is a serious problem for the Army. The GPS signal that affects every maneuver unit, Command, Communications, Computers, and Intelligence (C4I) network, and weapon system may not get through when it is most critically needed. Modernization efforts are focusing on embedded capabilities and protection of use of the PNT GPS system. The Navigation Warfare (NAVWAR) program, directed by the Under Secretary of Defense, Acquisition and Technology (A&T), to address known GPS vulnerabilities, is now a component of the GPS modernization program. NAVWAR examined design alternatives to provide enhanced military

performance and reduce vulnerability while maintaining uninterrupted civilian use. The Army anticipates upgrading or replacing all Army GPS receivers during the FY04-15 timeframe. Greater host vehicle dynamics and the need for interfaces to other navigation, communications or control systems will require enhanced capabilities for the Objective Force.

Weather, Terrain, and Environmental Monitoring (WTEM)

There are a number of phenomena that occur on the surface of the sun and in space, which can have a dramatic effect on communications and GPS signal reception and on radar systems. Knowledge of these "space weather" events and assessment of when, how, and to what degree friendly systems will be affected allows commanders to plan around periods of signal interruptions.

Detailed, current knowledge of local terrestrial weather also enhances operational planning. Tactical commanders need terrestrial weather systems to provide weather without the current 4-8 hour latency. The emerging capability to integrate near-real-time "tactical weather" from weather satellites will greatly enhance the planning capability of Legacy to Objective land forces by providing detailed, current knowledge of local weather conditions. Modernization will provide current information and enhance dissemination so that it can be integrated more effectively into the battlespace planning process.

Army forces also require on-demand, accurate terrain data and maps of specific theaters and areas of operation around the world. The digital terrain data is used in simulators to accomplish mission planning and rehearsals or to provide updated map products to land forces**.** Space assets provide the capability to meet that need. While currently limited to specific major theaters, evolving capabilities will provide global digital and 3D terrain products, enhancing battlefield visualization, operational planning, and targeting for Objective Force units.

Environmental monitoring capabilities of space assets also provide key information to land force commanders. Our ability to conduct Intelligence Preparation of the Battlespace (IPB) in the Objective Force can be enhanced by hyperspectral imagery (HSI) from space. HSI allows us to detect environmental changes that heretofore could only be detected by soldiers on the ground (usually too late to have been considered in any operational planning). Additional capabilities include soil saturation monitoring for trafficability analysis, manmade or natural obstacle detection and avoidance, and observation and prediction of the effects of Weapons of Mass Destruction (WMD). Current warfighter experiments, which leverage civil and commercial space assets, are examining the use of HSI to support the warfighter. As the technology develops, this capability will be integrated into the planning process to support the Objective Force.

Missile Warning (MW)

Early, accurate, focused MW is critical to full spectrum protection for targeted forces and critical assets and to minimize impact on nontargeted forces. Army JTAGS receive and process in-theater, direct, downlinked data from DSP satellites. This Army/Navy joint interest program (led by the Army) responds to accuracy and timeliness deficiencies in MW that were identified during Operation Desert Storm. Currently, DSP satellites detect the launch of a ballistic missile, track the missile, and provide data directly to JTAGS, located in theater. JTAGS makes and disseminates impact point predictions to implement warning and alerts/cues active missile defenses, and the system provides launch point determinations that can be used to trigger attack operations. JTAGS modernization will take advantage of more capable sensing satellites currently being developed.

Intelligence, Surveillance, and Reconnaissance (ISR)

Space assets allow us to “see and hear” the enemy from the ultimate high ground—without putting soldiers at risk. On-demand, tailored ISR data is key to the tactical-level commander's decisive action, information dominance, and high OPTEMPO with short decision cycles. Getting this information disseminated directly to the warfighter is a key focus of Army space modernization. The near-term strategy to modernize ISR assets is to reduce the number of systems involved in receiving and disseminating ISR data for the land component commander. On-demand, tailored ISR data to tactical-level commanders is the key to achieving the Army space operations concept. In addition to direct downlink capabilities to support the Objective Force commander’s concept of operation, full spectrum dominance and Objective Force characteristics require direct, dynamic tasking and retasking capabilities for ISR assets. Mobile, dynamic networks and the seamless integration of terrestrial, airborne, and space communications will allow information to be distributed among sensors, warriors, weapons platforms, and support bases, allowing land force commanders to exploit speed and knowledge to increase Objective Force OPTEMPO.

Space Control

The ability of the Army to execute the enhanced operational concepts of *JV 2020* and to maintain information superiority depends more and more on space assets. We must, therefore, minimize our vulnerabilities and assure the land component commander’s access to space capabilities. A key element of this assurance is the ability to accomplish space control. Space control includes the elements of prevention of an adversary's use of our or a third party's space systems; the protection of our space assets; the surveillance necessary to maintain information awareness of the space battlespace; and, if necessary, the ability to negate an adversary’s space capabilities. Part of the Army's space modernization program is to develop the suite of technologies and Doctrine, Training, Leader Development,

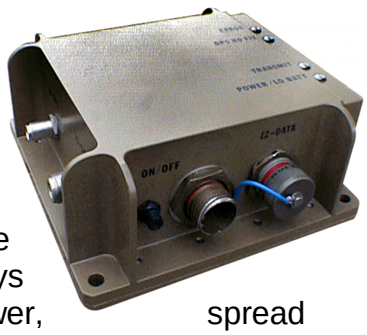
Organization, Materiel, and Soldiers (DTLOMS) solutions to assure access to required space capabilities for the Objective Force.

Space Modernization Programs

Current Army space systems must be modernized to keep pace with warfighter demands for increased user information volume, accuracy, security, timeliness, and reliability. Since the Army's investment in space is primarily in ground terminals, Army space systems and PPIs to those systems must account for future architecture and spacecraft advancements. The Army participates in the development of future space system architectures and spacecraft in order to minimize the required modifications to ground programs and to ensure that the ground terminal programs keep pace with the spacecraft and system architecture advancements. Information on selected space systems is provided below. Additional information and systems are covered in other appropriate annexes.

Grenadier BRAT (GB) (Beyond Line-of-Sight Reporting and Tracking)

Description. The GB terminal is a small transmitter box with two antennas. The system employs low- output power, spread spectrum, and short-burst UHF transmissions. GB's low probability of detection (LPD)/low probability of intercept (LPI) waveform is compatible with Aviation and Special Operations. GB uses the same LPI/LPD used by the Combat Survivor Evader Locator (CSEL) radio being fielded to all Services. It integrates with the Enhanced Position Location Reporting System (EPLRS) and joint protocols and communications, leveraging existing infrastructure to include communications relay systems, worldwide broadcast systems, and existing command and control systems.



Operational Requirement. GB, a Warfighter Rapid Acquisition Program (WRAP), receives location and time data from the GPS system and transmits this information, along with a unique vehicle, equipment, or personnel identifier to receiving command centers. Using embedded brevity codes, operators can also transmit status reports. It is a cost-effective enhancement to situational awareness that extends force tracking beyond line-of-sight, designates extended-range targets, monitors force status in immature theaters, and extends digitized situational awareness to nondigitized forces or coalition members.

Program Status. A limited buy of 450 GB for Special Operations Forces (SOF) and selected units is currently being fielded. In the mid-term, a GB follow-on with two-way communications is planned. In the far-term, an evolution of GB is planned to include high data rate communications of voice, data and imagery for the Objective Force.

Big Crow

Description. Big Crow is a series of Electronic Warfare (EW)-capable ground and airborne suites that were previously used exclusively for developmental and operational test and evaluation of radar, missile, and sensor systems.

Operational Requirement. While serving as a test and evaluation asset, Big Crow demonstrated potential for service as a space control platform. As a result of its space control application potential, Big Crow has been transferred to SMDC where it will also serve as an Army space control asset.

Program Status. The Army is currently seeking funding to maintain the system operations and to support Legacy and Interim Forces.

Joint Tactical Ground Station (JTAGS)/Multimission Mobile Processor (M3P)

Description. JTAGS can be deployed worldwide. The normal deployment complement, a JTAGS detachment, consists of two JTAGS units that provide the necessary survivability and redundancy to satisfy the requirement for continuous MW operations in support of a theater. Each unit includes a JTAGS shelter, external collapsible high-gain antennas, a standard military generator, and standard five-ton trucks as prime movers. JTAGS can be deployed via ship or C-141 or larger aircraft and is transportable over primary roads.

Operational Requirement. JTAGS alerting and cueing using DSP data enhances the capabilities of the Patriot Air and Missile Defense systems today. Its modernized M3P will do the same for the Theater High Altitude Area Defense (THAAD) and Medium Extended Air Defense (MEADS) systems for the Legacy through Objective Forces using more accurate SBIRS data. Accurate launch point location from JTAGS/M3P enhances the lethality of attack operations for all joint deep-fire systems. Supplemental warning and alarm systems, using JTAGS/M3P information and space-based communication means, will improve survivability of all our deployed forces.

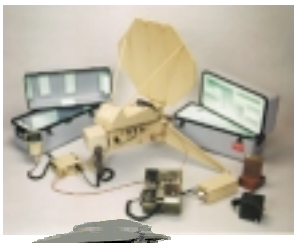
Program Status. Ongoing modernization to the M3P will enable JTAGS to receive, process, and disseminate data from the follow-on SBIRS satellites that will provide more

accurate information on a greater variety of threats, providing increased protection for deployed forces.

Communications Satellite Terminals

Description. The modernization of the full range of SATCOM terminals is detailed in the Command, Control, and Signal Systems annex of this plan (Annex E, Information Superiority). The result of the modernization will be more mobile and versatile terminals fielded in greater numbers to support the warfighter.

Operational Requirement. SATCOM modernization is necessary just to meet today's high demand to extend terrestrial communications and provide increased capacity. Legacy and Interim Forces require the more mobile, multipurpose Single Channel Anti-jam Man-Portable (SCAMP), the multi channel SHF Tri-Band Advanced Range-Extension Terminal (STAR-T), and the Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T) Extremely High Frequency (EHF) systems. These systems will be augmented for high-volume, one-way information flow by the GBS system, which will be available for the Legacy, Interim, and Objective Forces. The key to meeting Objective Force requirements will be the fielding of the Multi-Band Integrated Satellite Terminal (MIST). MIST's expanded frequency capability will provide the flexibility and deployability required by future Army forces and will reduce the number of SATCOM systems while providing increased capability such as SATCOM on-the-move.



Program Status. SCAMP, STAR-T and SMART-T terminals are now being fielded. GBS terminals should be available by the end of FY01.

Global Positioning System (GPS)

Description. GPS is a space-based navigation system that distributes positioning, velocity, and time (PVT) data. It has three segments: a space segment (24 satellites), a ground control segment, and a user equipment segment. User equipment consists of receivers configured for handheld use with ground, aircraft, and watercraft applications. Military GPS receivers have Precise Positioning Service (PPS) capabilities that provide enhanced accuracy and signal protection; commercial units do not. The Army represents over 80% of the Department of Defense (DoD) requirement for user equipment. Systems include the Precision Lightweight GPS Receiver (PLGR), the Small Lightweight GPS Receiver (SLGR), the Standalone Air GPS

Receiver (SAGR), the Cargo Utility GPS Receiver (CUGR), the Defense Advanced GPS Receiver (DAGR), the GPS Receiver Applications Module (GRAM), and the GPS Inertial Navigation System (GPS/INS).

Operational Requirement. GRAM and GPS/INS will allow the integration of new GPS technology to a broad range of host platforms and vehicles. The GPS Tactical Operational Requirements Document projects the total number of receivers required during this timeframe to exceed 650,000 at an estimated initial procurement cost of $1.5 billion. In addition to Army efforts to modernize user segments to reduce vulnerabilities, enhanced capabilities for Objective Forces will also require a modernized space segment for GPS.

Program Status. The Army has acquired more than 83,000 PLGRs, the primary handheld GPS receiver. Most SLGRs, a commercial GPS receiver bought during Desert Storm, have been removed from service except for interim use in some aircraft. The Defense Advanced GPS Receiver (DAGR) has been designated a Horizontal Technology Integration (HTI) initiative and will incorporate design changes dictated by GPS modernization. The DAGR will replace most PLGRs.

Integrated Meteorological System (IMETS)

Description. IMETS is a High-Mobility Multipurpose Wheeled Vehicle (HMMWV)-mounted tactical system that provides automation and communications support to staff weather teams assigned to echelons from brigade through echelons above corps (EAC) and to Army SOF. IMETS receives polar-orbiting civilian and defense meteorological satellite information from the Air Force Global Weather Center and integrates this weather information with data from artillery meteorological teams, remote sensors, and civilian forecast centers.

Operational Requirement. The IMETS is an integral part of the Army's digitization effort. The system provides first-in weather support to contingency forces, tailored weather information for deep fires and precision munitions, and weather effects decision aids for the planning and execution of maneuver and support. It processes and collates forecasts, observations, and climatological data to produce timely and accurate weather products tailored to the specific warfighter's needs. The automated tactical decision aids produced by the IMETS display the impact of the weather on current, projected, or even hypothesized conditions on both friendly and enemy capabilities. Instead of reacting to the weather, the warfighter can take advantage of the weather.

Program Status. HMMWV-mounted IMETS are currently being fielded for echelon above corps units and aviation battalions. Light and command post configurations are also under development.

Digital Topographic Support

System (DTSS)

Description. DTSS is a standard, automated, tactical combat support system capable of receiving, formatting, creating, manipulating, merging, updating, storing, and retrieving digital topographic data and multispectral imagery data from the National Imagery and Mapping Agency's (NIMA) standard digital databases, commercial or civil sources, and national technical means assets. It then processes these data into hardcopy and softcopy topographic products for warfighters. The system uses the latest commercial off-the-shelf technology in printers, scanners, and computer workstations combined with image processing and geographic information system software. DTSS is supported by environmental control units, generators, and communications equipment that are part of the standard Army inventory.

Operational Requirement. The DTSS will provide updated map background, terrain intelligence, and terrain data management to all the Army Battle Command System (ABCS) workstations on the battlefield and accept terrain intelligence/data updates from these systems. It will provide commanders at brigade through echelons above corps with automated terrain analysis, terrain database management, and graphics reproduction in support of intelligence preparation of the battlefield, command and control, terrain visualization, and weapons and sensor systems.

Program Status. The tactical system is being produced in two variants: heavy (DTSS-H) and light (DTSS-L). DTSS-H is housed in a 20-foot International Standards Organization (ISO) shelter and mounted on a standard 5-ton truck. DTSS-L will be housed in a lightweight multipurpose shelter mounted on a HMMWV. A Preplanned Product Improvement (PPI) program for DTSS will ensure topographic support that meets warfighter needs through the Objective Force.

The Tactical Exploitation System (TES)

Description. The Army relies on the TENCAP system to access national ISR data through SATCOM links. TES combines TENCAP functionality in a single integrated, scaleable system designed for split-based operations. TES will replace the Advanced Electronic Processing and Dissemination System (AEPDS), Enhanced Tactical Radar Correlator

(ETRAC), and the Modernized Imagery Exploitation System (MIES). TES is designed for split-based deployment and will consist of forward and main elements. TES Forward is a highly mobile, HMMWV-based element configuration; TES Main is housed in vans. Each element has similar operational, communications, and support capabilities.

Operational Requirement. TES is designed to provide the commander with maximum flexibility to satisfy intelligence needs in a wide range of operational scenarios. TES replaces multiple systems and will reduce errors, costs, and deployment time into the theater. In the far-term, the TENCAP TES will evolve into an even more capable, more compact ground interface with sources of information to be integrated for the Objective Force. A Distributed TES (DTES), consisting of modular components of TES, is programmed for support to a division, but may also be available for Interim Brigade Combat Teams (IBCT). A TES Light, consisting of modular components of TES, is being considered for selected Army and SOF elements not requiring a vehicle-configured system.

Program Status. The TES program reflects the near-term modernization strategy. Forward TES has been fielded to XVIII Corps and full TES is currently being fielded there to maintain their combat overmatch capability and enhance their deployability. Five full TES systems and additional DTES assets are funded in the FY02-07 Plan and will be fielded in the near term.

Assessment

The modernization efforts outlined in this annex show that the Army is on the right path for transforming space capabilities and organizations to achieve the characteristics of the Objective Force. Much is left to accomplish.

The Doctrine, Training, Leader Development, Organization, Materiel, and Soldier (DTLOMS) solutions to space shortfalls are progressing well throughout the Army, particularly with the establishment of Functional Area 40, Space Operations Officer. Materiel solutions are more problematic. Many materiel solutions depend not only on allocation of scarce Army resources for the ground segment of space systems, but also on the allocation of resources external to the Army for the space segment modernization. To optimize future investments, the Army must derive and quantify warfighter space requirements and synchronize solutions with the other Services, DoD, other government agencies, and the commercial sector. This process requires support for new initiatives, reprogramming of some existing or planned programs, and perhaps cancellation of others.

The Army will continue to exploit and leverage space capabilities of other

Services and organizations and must be prepared to participate substantively in investments made by them. When commercial systems show promise to satisfy requirements and have applicability to Army modernization efforts and future warfighting, the Army will need to invest near-term resources to achieve a potential significant future return on that investment.

Finally, the Army must protect its investment in space and develop the space control and related measures that will assure access to those capabilities that are required to accomplish Transformation and enable the Objective Force.